

Claims

- 1 1. A method of calculating a modification of a geometrical shape, comprising the steps of:  
2 defining on a multi-dimensional space an array of values representing a geometrical  
3 shape;  
4 selecting a modification function that represents a desired modification to be applied to  
5 the geometrical shape;  
6 applying an inverse function of the modification function to the array of values to produce  
7 a modified array; and  
8 deducing from the modified array a modification of the geometrical shape that would  
9 result from a direct application of the modification function to the array.
- 10 2. The method of claim 1, further comprising the step of applying the deduced modification  
11 to the array.
- 12 3. The method of claim 1, further comprising displaying to a user the modification of the  
13 geometrical shape that would result from a direct application of the modification function to the  
14 array.
- 15 4. The method of claim 1, wherein the step of deducing from the modified array a  
16 modification further comprises the steps of:  
17 retrieving an array value from the modified array; and  
18 applying the array value from the modified array at a location in the array representing the  
19 geometrical shape.
- 20 5. The method of claim 1, wherein the modification function comprises a soft-edged  
21 deformation.
- 22 6. The method of claim 1, wherein the modification function is applied from a selected one  
23 of a first side and a second side of the geometrical shape.

- 1 7. The method of claim 1, further comprising applying the modification function by  
2 manipulation of a virtual tool.
- 1 8. The method of claim 7, wherein the geometrical shape is displaced away from the virtual  
2 tool.
- 1 9. The method of claim 7, wherein the geometrical shape is displaced toward the virtual  
2 tool.
- 1 10. The method of claim 9, wherein the modification of the geometrical shape is substantially  
2 a convex hump.
- 1 11. The method of claim 9, wherein the modification of the geometrical shape is substantially  
2 a concave spiked protuberance.
- 1 12. The method of claim 1, wherein the modification function comprises a force field  
2 consistent with a tool of arbitrary shape.
- 1 13. The method of claim 1, wherein the modification function comprises translational  
2 displacement.
- 1 14. The method of claim 1, wherein the modification function comprises rotational  
2 displacement.
- 1 15. The method of claim 1, wherein the modification function comprises a selected one of a  
2 displacement function, a smoothing function, a warping function, a volumetric interference, an  
3 areal interference, a result of a simulation, a data re-fitting, and a force.
- 1 16. The method of claim 1, wherein the modification function is represented as a non-linear  
2 mathematical function.

1 17. The method of claim 1, further comprising the steps of:  
2 selecting a second modification function;  
3 applying an inverse function of the second modification function to the modified array to  
4 produce a twice-modified array; and  
5 deducing from the twice-modified array a modification of the geometrical shape that  
6 would result from an application of the modification function to the array followed by  
7 an application of the second modification function to the once-modified array.

1 18. The method of claim 1, wherein the modification comprises applying a constraint so as to  
2 control a magnitude of a change of the geometrical shape.

1 19. The method of claim 18, wherein applying the constraint prevents at least one point of the  
2 geometrical shape from moving in response to the application of the inverse function of the  
3 modification function.

1 20. The method of claim 1, wherein the modification comprises applying a surface texture to  
2 the geometrical shape.

1 21. A system for calculating a modification of a geometrical shape, comprising:  
2 a generation module that defines on a multi-dimensional space an array of values  
3 representing a geometrical shape;  
4 a selection module that provides a modification function representing a desired  
5 modification to be applied to the geometrical shape;  
6 a transformation module that applies an inverse function of the modification function to  
7 the array of values to produce a modified array; and  
8 a calculation module that deduces from the modified array a modification of the  
9 geometrical shape that would result from a direct application of the modification  
10 function to the array.

- 1 22. The system of claim 21, further comprising a modification module that applies the  
2 deduced modification to the array.
- 1 23. The system of claim 21, further comprising a display module that displays to a user the  
2 modification of the geometrical shape that would result from a direct application of the  
3 modification function to the array.
- 1 24. The system of claim 21, wherein the calculation module further comprises:  
2 a module that retrieves an array value from the modified array; and  
3 a module that applies the array value from the modified array at a location in the array  
representing the geometrical shape.
25. The system of claim 21, wherein the modification function comprises a soft-edged  
deformation.
26. The system of claim 21, wherein the modification function is applied from a selected one  
of a first side and a second side of the geometrical shape.
- 1 27. The system of claim 21, further comprising a module that applies the modification  
2 function by manipulation of a virtual tool.
- 1 28. The system of claim 27, wherein manipulation of a virtual tool displaces the geometrical  
2 shape away from the virtual tool.
- 1 29. The system of claim 27, wherein manipulation of a virtual tool displaces the geometrical  
2 shape toward the virtual tool.
- 1 30. The system of claim 29, wherein the modification of the geometrical shape is  
2 substantially a convex hump.

- 1 31. The system of claim 29, wherein the modification of the geometrical shape is  
2 substantially a concave spiked protuberance.
- 1 32. The system of claim 21, wherein the modification function comprises a force field  
2 consistent with a tool of arbitrary shape.
- 1 33. The system of claim 21, wherein the modification function comprises translational  
2 displacement.
- 1 34. The system of claim 21, wherein the modification function comprises rotational  
2 displacement.
- 1 35. The system of claim 21, wherein the modification function comprises a selected one of a  
2 displacement function, a smoothing function, a warping function, a volumetric interference, an  
3 areal interference, a result of a simulation, a data re-fitting, and a force.
- 1 36. The system of claim 21, wherein the modification function is represented as a non-linear  
2 mathematical function.
- 1 37. The system of claim 21, further comprising:  
2 a selection module that selects a second modification function;  
3 a transformation module that applies an inverse function of the second modification  
4 function to the modified array to produce a twice-modified array; and  
5 a calculation module that deduces from the twice-modified array a modification of the  
6 geometrical shape that would result from an application of the modification function to  
7 the array followed by an application of the second modification function to the once-  
8 modified array.
- 1 38. The system of claim 21, wherein the modification comprises applying a constraint so as  
2 to control a magnitude of a change of the geometrical shape.

1 39. The system of claim 38, wherein the module that applies the constraint prevents at least  
2 one point of the geometrical shape from moving in response to the application of the inverse  
3 function of the modification function.

1 40. The system of claim 21, wherein the modification comprises applying a surface texture to  
2 the geometrical shape.

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